estec

European Space Research
and Technology Centre
Keplerlaan 1
2201 AZ Noordwijk
The Netherlands
T +31 (0)71 565 6565
F +31 (0)71 565 6040
www.esa.int

European Commission
Radio Spectrum Policy Group – Secretariat
DG CNECT B4: Spectrum – Office: BU33 7/065
European Commission, B-1049 Bruxelles,
Belgium
CNECT RSPG (CNECT-RSPG@ec.europa.eu)

Noordwijk, 7 January 2018

Our Ref: **EOP-ΦMT/2017-12-2048/EDE**, issue 1.1 (7th Jan 2018)

Subject: **ESA Response to the European Commission's RSPG Consultation on "Strategic Spectrum Roadmap Towards 5G for Europe: DRAFT RSPG Second Opinion on 5G networks" (RSPG17-034)**

The European Space Agency (ESA) welcomes the opportunity to respond to the European Commission's Radio Spectrum Policy Group (RSPG) consultation on the *"Strategic Spectrum Roadmap towards 5G for Europe: Draft RSPG Second Opinion on 5G networks*", published on 21st November 2017.

ESA recognizes the importance of IMT 5G for Europe and understands the efforts of RSPG to enable a timely deployment of 5G in Europe, by ensuring availability of the required spectrum in different frequency ranges to meet the diverse 5G requirements. In fact ESA cooperates with the IMT 5G industry for identifying the complementary role that satellites could play in this context.

ESA participates in the CEPT and ITU-R study groups in preparation of the WRC-19 decision on the identification of bands for future developments of the terrestrial component of IMT-2020 5G systems under Agenda Item 1.13.

As described in this document, it is of fundamental importance for ESA to ensure that any new band above 24 GHz identified for IMT 5G use at WRC-19 will not adversely impact operations of ESA systems of other services (specifically: the Earth Exploration Satellite Service (EESS), the Space Research Service (SRS) and the EESS(passive)), nor impair Europe's competitiveness in the flourishing commercial Earth observation sector.

Elena Daganzo

ESA Earth Observation Frequency Management
Elena.Daganzo-Eusebio@esa.int

MAIN AREAS OF CONCERN FOR ESA

ESA is particularly concerned with the identification of frequency range 24.25-27.5 GHz[*] for harmonized IMT 5G usage in Europe ahead of any WRC-19 decision on the subject. ESA is also concerned that some opinions and recommendations contained in the "draft RSPG 2nd opinion on 5G networks" appear to be in contradiction with agreements taken in CEPT with respect to the on-going compatibility studies for IMT 5G identification in the 26 GHz range.

ESA, as well as several European entities involved in the rapidly developing commercial Earth observation sector, have important on-going and planned initiatives that require long-term availability of the frequency range 25.5-27 GHz to transmit to Earth an increasing volume of satellite data. The EESS and SRS services have a primary allocation in such band, which constitutes the only viable frequency spectrum resource for Meteorological, Earth observation and Space Research satellites with high data downlink requirements. Many of these satellites contribute to European initiatives under the EC's DG-GROW, namely the Copernicus programme.

If not accompanied by suitable technical limitations and internationally applicable rules, ESA considers that the identification in Europe of the band 24.25-27.5 GHz for international harmonization would present serious risks of adversely impact current and future developments by ESA and by European industry. These developments are necessary to allow the utilisation of space for the benefit of the European citizens and economy

A description of the ESA space systems that may be impacted by the identification of IMT 5G bands under WRC-19 AI 1.13 is provided in the **Annex 1**. It is to be noted that a number of space systems listed in this Annex are key elements of the EU's Copernicus programme.

ESA has four main areas of concern with respect to the RSPG Opinion:

I. IMT deployments outside urban and suburban areas for bands above 24 GHz

In the 25.5-27 GHz band, the deployment models for 5G mobile communication services provided by ITU-R WP 5D to perform compatibility analysis target urban and suburban areas. Based on these deployment models, analyses indicate that the co-existence of IMT 5G systems and EESS/SRS Earth stations will require to define coordination/exclusion zones around each station (typically about 50 km around SRS stations, and 4 - 7 km around EESS stations).

Although there is no expectation that the 26 GHz band will be used for contiguous nationwide coverage of mobile networks, this RSPG document under consultation identifies a need for hotspots also in rural areas (see RSPG Opinions 2 and 3). ESA is of the view that IMT 5G deployments in the 26 GHz band in Europe should be limited to urban and suburban areas, as stated by ITU-R WP 5D and as assumed in all the compatibility studies made so far in CEPT and in ITU-R. No deployment

[*] *The frequency range 24.25 – 27.5 GHz is also referred to in this document as the "26 GHz band".*

outside these areas has been considered in the current studies and no technical/operational characteristics are available from WP 5D for IMT 5G systems in rural area (EIRP, antenna height, cell size, etc ...) to allow proper compatibility studies.

ESA notes that "de facto" sharing the 26 GHz band with IMT 5G systems will imply that future EESS Earth stations in many cases will only be allowed for deployment outside of urban and suburban areas, which is already severely penalising in particular the commercial EO initiatives that assume direct downlink of imagery data to users. If also deployments in rural areas are now considered, then obtaining licenses for future Earth stations will become almost impossible. Suitable locations would then be reduced to extremely remote areas, where no industrial buildings, main roads or train tracks will be present. This would contradict the WRC-19 Resolution for Agenda Item 1.13 that states the need to ensure future deployment of EESS/SRS Earth stations.

Furthermore, the still TBD technical/operational characteristics of IMT 5G systems deployed in rural areas would imply larger coordination/exclusion zones around EESS/SRS Earth stations than the zones calculated so far using the technical/operational assumptions for urban/suburban IMT 5G stations.

II. Possibility for individual administrations to decide for licences regimes different from individual licences for IMT 5G in the 26 GHz range

ESA considers that IMT 5G devices at 26 GHz should only operate under individual authorisation regime by the relevant national administration. Technical conditions related to coexistence with other services, in particular for the protection of EESS/SRS Earth stations, have been developed on the assumption of individual authorisation.

Any other assumption on the authorization framework, either general authorisation or a combined individual/general authorisation regime would:

1. Invalidate the concept of coordination/exclusion zone, since the IMT 5G base station (BS) location would not be known;
2. Allow uncontrolled IMT 5G devices being introduced with no possibility for administrations to verify their conformity to the required operational/technical characteristics. This would be a similar case to what happened in the 5GHz range with unlicensed RLAN deployment, where a large number of these unlicensed devices are not respecting the required technical/operational characteristics that were defined to ensure protection of the other services.

III. Possibility for individual administrations to decide the sharing conditions associated to the introduction of IMT 5G in the 26 GHz range

As explained above (point I), to ensure protection of the EESS/SRS stations it is necessary to define "exclusion zones" free of IMT 5G systems around the stations. ESA is of the view that the sharing conditions ensuring that the 26 GHz IMT 5G deployment in Europe will provide protection of the EESS/SRS stations at 26 GHz,

need to be defined at WRC/ITU level or, as a minimum, at European level, as per "CEPT Roadmap for 5G". ESA would actually favour a solution whereby these mechanisms are agreed at WRC/ITU level. Only an internationally agreed recommendation, providing the methodology to be followed to calculate the exclusion zones around EESS/SRS Earth stations, will ensure the deployment of future stations, as requested by WRC-19 Resolution for Agenda Item 1.13. Leaving the application of such a recommendation to individual administrations would not be in line with this WRC-19 AI 1.13 requirement.

IV. Protection of EESS(passive) systems operating in frequency bands adjacent or near-by to the potential IMT 5G bands under consideration, in particular the EESS(passive) in 23.6-24.0 GHz

Differently from the other existing services, no mention is made in the RSPG opinion document about the need to protect EESS(passive) systems beside a single quick reference to adjacent bands (in page 11) not followed by any further consideration.

ESA has developed and operates a number of passive microwave sensors in adjacent or nearby bands considered for IMT 5G identification which would suffer from harmful interference caused by unwanted emissions of IMT 5G deployments (see details in Annex 1). These passive microwave sensors, which are indispensable for observations of weather and climate as well as of the Earth's environment from space, require access to uncontaminated frequency bands, where each band provides essential information on specific phenomena. This is because passive microwave sensors use specific frequencies that uniquely correspond to resonances of important atmospheric molecules and cannot be changed, as they are fixed by nature. These frequency bands need to be free of radio interference to ensure the usefulness and correctness of the measurements, which is acknowledged through ITU Radio-Regulations footnote 5.340. Thus, it is of outmost importance to limit unwanted emissions of IMT 5G systems into the EESS passive sensing frequency bands (namely 23.6-24 GHz, 31.3-31.8 GHz, 36-37 GHz, 50.2-50.4 GHz, 52.6-54.25 GHz and 86-92 GHz bands) to the extent required to protect these measurements.

The studies presented in ITU and CEPT consistently show that the current IMT-2020 unwanted emissions levels would be largely insufficient to ensure protection of the EESS (passive) sensors in the 23.6-24 GHz band and that only a drastic reduction of the IMT-2020 emissions in the 23.6-24 GHz can ensure such protection. ESA is deeply concerned about this situation. It is to be noted that the on-going work in 3GPP to address such unwanted emissions reduction is still not conclusive.

ESA'S COMMENTS TO THE "DRAFT SECOND RSPG OPINION ON 5G NETWORKS"

The RSPG 2nd opinion on 5G networks is presented in Doc. RSPG17-034 as a set of ten points (pages 4-5), plus an Annex supporting these opinions. Here below ESA comments are provided per RSPG opinion items:

- ***RSPG Opinion No.1:*** *The Member States will need flexibility in the way they authorise access to spectrum, for example: appropriate geographical areas (e.g. national, regional, city or hyper-local, e.g. for use in a factory), individual licencing or under a general authorisation framework.*

  ESA comments: ESA is of the view that spectrum authorisation for IMT 5G in the 26 GHz range needs to be by individual licencing. ESA is concerned that a general authorisation framework would lead to an IMT 5G scenario difficult to control by the Member States, in terms of deployment and technical characteristics, and therefore would pose a risk to ensure protection of EESS/SRS receiving Earth stations. (See also "ESA concern II" above)

- ***RSPG Opinion 2:*** *The Commission, together with Member States, should take actions to fully support 5G related policy objectives in rural areas and wide coverage, taking into account the role of satellite in achieving ubiquitous connectivity.*

  ESA comments: ESA agrees with RSPG opinion that the EC and Member States should support 5G in rural areas, provide wide coverage, and in particular with the recognition of the role of satellites. However, ESA considers that the 26 GHz band should not be identified for hotspots in rural areas, major roads or railway tracks outside urban/suburban areas, as this would make difficult the future deployment of 25.5-27 GHz EESS stations in Europe. Instead, other 5G candidate frequency bands should be used for this purpose. (See also "ESA concern I" above)

- ***RSPG Opinion 3:*** *The RSPG recommends that the Commission, in its research work-programs, study solutions for improving 5G connectivity and wide area coverage, especially in rural areas, thereby facilitating and progressing technology developments targeting the fulfilment of 5G related policy objectives.*

  ESA comments: As for RSPG Opinion 2.

- ***RSPG Opinion 4:*** *Service performance and availability requirements may be relevant for some 5G cross border services to fully function and would need to be defined by the industry in a timely manner. In some cases an EU coordinated approach could be helpful in this regard to support a common European solution.*

  ESA comments: ESA has no comments on the 5G performance and availability requirements.

- ***RSPG Opinion 5:*** *Coverage obligations can only be derived as a consequence of national policy objectives and characteristics (i.e. population distribution, geographical morphology, industrial and societal needs) and therefore cannot be harmonised on a EU-level.*

  ESA comments: ESA has no comments on how to handle the 5G coverage obligations at national level.

- ***RSPG Opinion 6****: Solving issues relating to facilitating the efficient deployment of ultra-dense networks is expected to be of high importance for the rollout of 5G in dense urban areas. The RSPG is of the opinion that Member States should assess the need for national actions that will enable easier site authorisation and installation, in particular for small cells, in order to make timely 5G deployment possible.*

  ESA comments: ESA agrees about the importance to facilitate site authorization and installation of 5G small cells in dense urban areas. ESA considers that national actions will be needed to ensure an efficient individual licensing for IMT 5G cells in 26 GHz. ESA also consider that it will be necessary to identify what is the typical cell size to be considered as "small".

- ***RSPG Opinion No. 7****: All commercial licences in frequency bands identified for 5G within the Member States should be subject to trading or leasing to enable new market opportunities.*

  ESA comments: ESA has no comments on this point, provided this trading/leasing has no impact on the concept of individual licensing for 5G in 26 GHz.

- ***RSPG Opinion 8****: The RSPG is of the opinion that Member States should consider appropriate measures to defragment the 3.6 GHz band, the primary 5G band, in time for authorising sufficiently large blocks of spectrum by 2020.*

  ESA comments: ESA has no comments on this point.

- ***RSPG Opinion 9*** *in relation to the 26 GHz pioneer band (24.25-27.5 GHz):*

a) the focus of 5G authorisations in the 26 GHz band should be on an individual licence regime. However, the possibility of a general authorisation regime under sharing conditions that protect the other users of spectrum in this band (e.g. EESS/SRS) is not excluded.

ESA comments to opinion 9a: ESA disagrees with this RSPG opinion to consider "the possibility of a general authorization regime" as ESA is of the view that:

1. The technical/operational conditions that protect current and future EESS/SRS Earth stations could not be ensured and,
2. It would not allow ensuring the respect of coordination/exclusion zones around the SRS/EESS Earth stations.

ESA considers that it should not be left to the individual administrations to decide for licences regimes different than individual licences for IMT 5G in the 26 GHz range. Therefore, ESA proposes that IMT 5G devices at 26 GHz will only operate under individual authorization regime by the relevant national administration. (See also "ESA concern II")

b) *the Commission should include as part of any technical harmonisation for the 26 GHz band, in high level terms, the requirements to maintain the possibility for continued development of incumbent satellite services (FSS and EESS/SRS). Future earth stations should be authorised based on transparent, objective and proportionate criteria to safeguard their future operations and ensuring that they are unlikely to have a significant impact on 5G deployment and coverage. Member States will remain fully responsible for granting or rejecting authorisation to a new satellite earth station application.*

ESA comments to opinion 9b: ESA appreciates that requirements to maintain the possibility for continued development of EESS/SRS Earth stations in the 25.5-27 GHz band will be part of any technical harmonisation of IMT 5G the 24.25 – 27.5 GHz band. However, ESA disagrees that the authorisation or rejection of future EESS/SRS stations in Europe be driven by the condition that it is *"unlikely to have a significant impact on 5G deployment and coverage*".

The 25.5-27 GHz band is the only alternative available for Earth observation satellites with high data rate downlink requirements. As presented in Annex 1, most future Copernicus missions (Sentinel satellites) and ESA EO satellites will require the use of 25.5-27 GHz EESS receiving stations. It is important to note that the number and distribution of future Copernicus Earth station sites still needs to be determined as part of the definition process of the evolution of Copernicus. In addition, it is recalled that many commercial Earth observation initiatives – partly supported by ESA and/or EC programmes – target high-resolution imagery, which implies high data rate downlinks as well as, where rapid information delivery to users is needed, the ability to locate Earth stations close to the users (local users concept).

ESA disagrees with the RSPG opinion *"that the impact of satellite Earth stations on the deployment of 5G networks could be minimised if they are deployed in sparsely populated areas, away from major conurbations"* (page 12). ESA considers that imposing this condition to the future deployment of 26 GHz stations in Europe would not be in line with WRC-19 resolution for AI 1.13 (Res. 238), that in particular identified the need "to protect the deployment of future receiving earth stations under the EESS and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz".

c) *Member States should make by 2020 a sufficiently large portion of the band, e.g. 1 GHz, available for 5G in response to market demand, taking into account that 5G deployment in this frequency range is expected to be used for local coverage.*

ESA comments to opinion 9c: ESA is of the opinion that if the target by 2020 is to make available approximately 1 GHz bandwidth in the 24.25-27.5 GHz band, then the priority should be given to the upper part of the band (i.e. 26.5 – 27.5 GHz).

d) *Regulatory flexibility for the progressive release of the 26 GHz band will facilitate an efficient introduction of 5G without having an unnecessary negative impact on the current users of the band. Member States should plan any migration of fixed links necessary for ensuring the availability of the band for 5G, taking into account the geographical dimension of the market demand for 5G.*

ESA comments to opinion 9d: ESA considers that in determining the "regulatory flexibility" for the use of IMT 5G in the band 24.5-27.5 GHz, it is very important to take into account ITU Resolution 238 (WRC-15) that indicates the need "to ensure the protection of existing earth stations and the deployment of future receiving earth stations under the EESS (space-to-Earth) and SRS (space-to-Earth) allocation in the frequency band 25.5-27 GHz".

- ***RSPG Opinion 10:*** *General authorised frequency use can be an important breeding ground for innovation and contributes towards a dynamic market environment. The application of a general authorisation regime is foreseen in the 66-71 GHz band which could be an important band for 5G.*

ESA comments: No objection to the concept of general authorization applied to the 66-71 GHz band.

Attachment:

Annex 1 - Supporting information about ESA interests and systems potentially impacted by future IMT-5G systems

ANNEX 1: SUPPORTING INFORMATION ABOUT ESA SYSTEMS POTENTIALLY IMPACTED BY FUTURE IMT-5G SYSTEMS

The table below introduces which are the scientific bands potentially under threat by the IMT 5G candidate bands under study in WRC-19 Agenda Item 1.13:

WRC-19 Agenda Item	**Bands under consideration for IMT-5G**	**Scientific satellite bands under threat**
1.13: Identification of bands for **future developments of IMT-2020 (broadband, terrestrial component of 5G systems)**	24.25-27.5 GHz, 31.8-33.4 GHz, 37-43.5 GHz, 45.5-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz 81-86 GHz,	**1) Direct to ground payload data downlink from Earth Observation (EESS) and Science (SRS) missions:** 25.5-27 GHz **2) EESS payload data downlink via EDRS relay system:** 25.5-27 GHz Used for Copernicus Sentinel-1 and -2. *Note: The 25.5-27 GHz is also used to* **3) Inter-satellite links (ISS):** 24.45-24.75 and 25.25-27.5 GHz bands. **4) EESS (passive) remote sensing bands in adjacent (or near-by) bands to those intended for IMT 5G:** 23.6-24 GHz 31.3-31.8 GHz 36-37 GHz 50.2-50.4 GHz 52.6-54.25 GHz 86-92 GHz

Acronyms:

EESS	Earth Exploration Satellite Service
EESS(passive)	Earth Exploration Satellite Service (passive remote sensing)
SRS	Space Research Service
ISS	Inter-Satellite Service

The following table identifies different ESA interests that may be impacted by the identification of new bands for IMT 5G above 24.25 GHz (WRC-19 AI 1.13). It is to be noted that a number of space systems listed in below are key elements of the EC Copernicus programme (DG-GROW).

Type of Mission/ System	**ESA Interests**
Earth observation missions (EESS) using the 25.5-27 GHz band for direct LEO-to-ground communications	The 25.5-27 GHz band shall be used by the **next generation of Meteorological missions:** ✓ **EUMETSAT Meteosat 3rd Generation (MTG).** Total 6 GEO satellites: 4 MTG-I (Imager, 1st launch planned 2020) and 2 MTG-S (Sounder, 1st launch planned 2022). Operations until >2040. Currently planned two MTG ground segment sites at Lario (I) and Leuk (CH), with up to 4 antennas per site. Note: Copernicus **Sentinel-4** is a payload on board MTG-S. ✓ **EUMETSAT Polar System 2nd Generation (EPS-SG, MetOp-SG satellites).** 2 satellite configuration with 3 MetOp-SG satellite pairs: MetOp-SG series A (1st launch planned 2021) and series B (1st launch planned 2022). Operations until >2040. Currently planned two EPS-SG ground segment sites at Svalbard (N) and McMurdo (Antarctic). Note: Copernicus **Sentinel-5** is a payload on board Metop-SG-A. ✓ **NASA/NOAA Joint Polar Satellite System JPSS.** Several satellites: Suomi-NPP (Oct 2011), JPSS-1 (Nov 2017), JPSS-2 (2021), JPSS-3 (2026) and JPSS-4 (2031)**.** Currently planned JPSS ground segment sites at Svalbard (N), Fairbanks (AK USA), McMurdo and Troll (Antarctica).
	The 26 GHz band will be needed by most future Earth observation satellites generating a high data volume on-board and therefore requiring high data rate for direct downlink of payload data to ground: ✓ **Most future Copernicus missions** (Sentinel satellites)/ after 2025. The number and distribution of future Copernicus Earth station sites still needs to be determined as part of the definition process of the evolution of Copernicus. ✓ **Future ESA Earth Observation satellites** (after 2025) ✓ **High-resolution (optical or radar) imaging commercial satellites** (around 2020) No other alternatives available for the downlink of Earth Observation payload data if the 25.5-27 GHz EESS band becomes not safe for use.
Space science missions (SRS) using the 25.5-27 GHz band for direct payload data downlink	The 26 GHz band is already planned for use by several ESA science missions: ✓ Euclid (2020). ✓ Plato (2026) These missions will use the 35-m antenna ESA ground stations at Malargüe (Argentina), Cebreros (Spain) and New Norcia (Australia).

<table>
<tr><th>Type of Mission/ System</th><th>ESA Interests</th></tr>
<tr><td>Inter-satellite links (ISS) in range 24.45-27.5 GHz</td><td>The European Data Relay System-A (EDRS-A) has 27.2 GHz space-to-space receive capabilities.
Planned to be used by Columbus Ka-Band (COLka) terminal on the International Space Station (2018-2025).</td></tr>
<tr><td>EDRS receive ground stations in the band 25.5-27 GHz</td><td>The two EDRS satellites [EDRS-A (2014) and EDRS-C (2016)] have space-to-ground capabilities in the 25.5-27 GHz band. EDRS is currently used as one of the methods for relaying to ground the Sentinel -1 and -2 data for the Copernicus Programme.

Currently there are 3 EDRS receiving stations, at Weilheim (D), Redu (B) and Harwell (UK).</td></tr>
<tr><td>Passive remote sensors in the EESS(passive) band 23.6-24 GHz and in other higher frequency bands</td><td>The IMT 5G unwanted emissions must be compatible with the protection criteria of the EESS(passive) sensors operating in adjacent bands. The following European systems could be affected by excessive unwanted emission levels:

<table>
<tr><th>Instrument</th><th>Satellite</th><th>EESS (passive) band</th><th>IMT-2020 (5G) band</th></tr>
<tr><td>AMSU</td><td>Metop</td><td rowspan="6">23.6-24 GHz</td><td rowspan="6">24.25-27.5 GHz</td></tr>
<tr><td>MWS</td><td>Metop-SG</td></tr>
<tr><td>MWI</td><td>Metop-SG</td></tr>
<tr><td>AMR</td><td>Jason-2/3</td></tr>
<tr><td>MWR</td><td>Copernicus Sentinel-3</td></tr>
<tr><td>AMR-C</td><td>Jason-CS/ Copernicus Sentinel-6</td></tr>
<tr><td>AMSU</td><td>Metop</td><td rowspan="2">31.3-31.8 GHz</td><td rowspan="2">31.8-33.4 GHz</td></tr>
<tr><td>MWS, MWI</td><td>Metop-SG</td></tr>
<tr><td>MWR</td><td>Copernicus Sentinel-3</td><td>36-37 GHz</td><td>37-43.5 GHz</td></tr>
<tr><td>AMSU</td><td>Metop</td><td rowspan="2">50.2-50.4 GHz</td><td rowspan="2">47.2-50.2 GHz & 50.4-52.6 GHz</td></tr>
<tr><td>MWS, MWI</td><td>Metop-SG</td></tr>
<tr><td>AMSU</td><td>Metop</td><td rowspan="2">52.6-54.25 GHz</td><td rowspan="2">50.4-52.6 GHz</td></tr>
<tr><td>MWS, MWI</td><td>Metop-SG</td></tr>
<tr><td>AMSU</td><td>Metop</td><td rowspan="3">86-92 GHz</td><td rowspan="3">81-86 GHz</td></tr>
<tr><td>MHS</td><td>Metop</td></tr>
<tr><td>MWS, MWI</td><td>Metop-SG</td></tr>
</table>
</td></tr>
</table>